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Failure of Eruption of First Permanent Molar teeth: A diagnostic challenge

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Ankylosis, mechanical and primary failure of eruption of molar teeth are rare and often difficult to distinguish between. All may have significant repercussions on the occlusion and successful management may involve invasive procedures. We present a case where an initial presentation characteristic of mechanical failure of eruption (ankylosis) of a first permanent molar tooth was excluded following a period of monitoring. Subsequent relief of crowding using a removable and then sectional fixed orthodontic appliance allowed spontaneous eruption of the tooth obviating the need for surgical intervention. This case highlights the utilisation of conservative treatment options until a diagnosis was confirmed to minimise the risk of iatrogenic damage and unnecessary treatment.

Keywords: mechanical failure of eruption; impacted teeth

Introduction

The failure of first permanent molars to erupt may be attributed to a range of causes such as ectopic positioning, impaction or failure of eruption. Mechanical failure of eruption or single tooth ankylosis occurs due to the gradual resorption of the dental hard tissues and their replacement with bone (Hammarström et al. 1989). Typically, mechanical failure of eruption affects only a single tooth in the adult dentition commonly either the first or second permanent molar teeth (Sharma et al. 2016). Clinically, the affected tooth will either fail to erupt or occupy an infraoccluded position within the arch, elicit a high metallic sound on percussion and have reduced or absent mobility. However, reversal of ankylosis has been postulated (Andreasen and Kristerson 1981). On plain film radiographs, areas of ankylosis are typically evident on the proximal surfaces of teeth but unidentifiable on the labial or lingual area (Andersson et al. 1984). There may also be bone overlying the eruption pathway (Sharma et al. 2016). Mechanical failure of eruption is often confused or misdiagnosed as primary failure of eruption (Rhoads et al. 2013).

Primary failure of eruption (PFE) is described as non-ankylosed teeth that do not erupt due to a failure in the eruptive mechanism (Proffit and Vig 1981). The condition is rare with reported prevalence rates of 0.01% (Grover and Lorton 1985). A strong genetic component to the aetiology of PFE has been proposed (Decker et al. 2008; Frazier-Bowers et al. 2010). There are two classifications. Raghoobar distinguished between cases where the affected teeth do not erupt or where they do erupt but fail to obtain occlusal contact, termed primary or secondary retention respectively (Raghoobar et al. 1991). In contrast, three distinguishable forms have been proposed (Frazier-Bowers et al. 2007). Type I occurs due to a similar lack of eruptive potential of all affected teeth leading to a progressive open bite from anterior to posterior. In Type II, the teeth affected show a varied eruptive potential with some affected more than others. Type III has both subtypes co-existing in different quadrants. The failure of the eruptive mechanism in Type I appears to occur at a chronological point in time whilst in Type II it occurs at a particular stage of root development. PFE affects multiple teeth in multiple quadrants with the first permanent molar always involved. All teeth distal to the most mesially affected are involved leading to a posterior or lateral open bite. Percussion of erupted teeth affected can be negative for ankylosis. Radiographs will show the eruption pathway is usually not obstructed (Proffit and Vig 1981). PFE is also associated with a high rate of occlusal disturbances that may require orthodontic correction (Valmaseda-Castellón et al. 1999).

Case report

History and Examination

A medically fit and well 16-year-old male was referred by his general dental practitioner to the orthodontic department for the management of an unerupted maxillary right first permanent molar (UR6). He presented in the permanent dentition with a Class I malocclusion. Clinically, the maxillary right first permanent molar was unerupted, with spacing in the upper right quadrant and mesial and distal tipping of the maxillary right second permanent molar (UR7) and second premolar (UR5) respectively (Fig.1).

Radiographic examination confirmed the UR6 was present (Fig.1A-D). A provisional diagnosis of mechanical failure of eruption (ankylosis) was made. The option of surgically removing the UR6 was discussed, however in the absence of any concerns or pathology, given the complexity of the surgical procedure and associated risks, a decision to monitor the UR6 was agreed. The patient was reviewed the following year, at which there had been no changes clinically. A sectional orthopantogram was taken which when compared to the baseline radiograph indicated an improved vertical position of the UR6 suggesting continued eruptive potential of the tooth and a diagnosis of impaction (Fig. 2A-C). The patient and his mother were informed of this finding and an attempt was made to align the UR6 on a non-extraction basis.

Treatment

Orthodontic treatment was commenced with the aim of recreating space for the UR6 and monitoring its eruption. Initially an upper removal appliance was employed to open space in the region of the UR6. After six months of treatment a sectional orthopantogram confirmed further eruption of the UR6 (Fig. 3A-B). The upper removable appliance was discontinued, and a sectional fixed appliance (Pre-adjusted edgewise appliance, 0.022"x0.028" bracket slot with MBT prescription) was placed to further open space for the UR6 and to facilitate alignment of the tooth (Fig. 4A-D). A slightly infra-occluded position of the UR6 was accepted at the end of treatment (Fig.5A-B).

Discussion

This case presented with a characteristic appearance of mechanical failure of eruption of the UR6. The inability to differentiate between MFE and PFE during dental development has led to the term indeterminate failure of eruption as a transitory diagnosis (Frazier-Bowers et al. 2007). Management options for both entities differ and hence a monitoring period is recommended until a definitive diagnosis is made (Sharma et al. 2016). PFE was excluded for the following reasons: radiographic imaging suggested continued eruption of the UR6, the path of eruption of the UR6 was impeded, the UR7 had erupted and no other molar teeth were affected. The effects of MFE on the occlusion will

vary based on the stage of dental development when the ankylosis occurs. With early ankylosis, the negative effects on occlusal development can be significant with space loss and tipping of neighbouring teeth (Kuroi 2006). Both were demonstrated in this case. The ankylosed tooth can also interfere with vertical growth of the alveolar process, compromising the development of sufficient bone (Andersson and Malmgren 1999). In contrast, late ankylosis, results in only slight infraocclusion and the permanent molar can be left with no future periodontal problems anticipated (Kuroi 2006). The diagnosis was confirmed from plain film radiographs. Superimposition of the orthopantomogram radiographs along the orbital floor were used to demonstrate continued vertical development. Growth of the orbit is 95% complete by the age of fifteen in boys and eleven in girls (Furuta 2001). Orbital height and breadth increase is minimal after this age (Lang 1983). The orbital floor was therefore used as a stable reference point. It has also been used, via a line constructed between right and left orbitale to monitor orthodontic distalisation of molar teeth (Bansal et al. 2015).

Treatment options for MFE will vary based on whether the tooth has erupted, the level of infraocclusion and the effects on the adjacent teeth. The malocclusion may be accepted, the affected tooth surgically removed or restoratively treated if erupted (Sharma et al. 2016). Compensating extractions of overerupted opposing teeth or adjunctive orthodontic treatment to align adjacent tipped teeth may also be necessary (Sharma et al. 2016). Autotransplantation, single tooth segmental osteotomies followed by distraction osteogenesis and surgical luxation followed by orthodontic extrusion have also been successful, although reankylosis may reoccur (Kuroi 2006; Kang et al. 2016; Pithon 2016). Treatment should be deferred until the patient has stopped growing as alveolar development may lead to further infraocclusion (Sharma et al. 2016). Surgical extraction may also lead to atrophy of the bone compromising future prosthetic treatment (Andersson and Malmgren 1999). Active treatment options considered in this case included extraction of the UR6 with or without orthodontic space closure and space opening followed by prosthetic replacement. The latter option would have committed the patient to life-long maintenance and care. However, as the patient was unconcerned no treatment was initially instigated.

The period of observation was beneficial in this case as it revealed the unexpected vertical development of the unerupted tooth. The reason for the reversal in the eruptive potential of this tooth is unknown however, ankylosis may be a reversible process (Andreasen and Kristerson 1981). Transient ankylosis may have prevented initial eruption of the UR6. The tooth may have proceeded to erupt if the UR7 had not mesially tipped in the intervening development period. However, the ability to regain eruptive potential following signs of failure of eruption is rare (Mistry et al. 2017). Alternatively, the first molar may have been impacted against the second deciduous molar. If the second premolar was late forming, late exfoliation of the deciduous tooth may have maintained the position of the unerupted tooth until after the second molar had erupted. Regardless of the cause, the prognosis of impacted molar teeth is relatively guarded (Valmaseda-Castellón et al. 1999). Advanced age at diagnosis, the severity of the impaction and uncertainty of conservative treatment contribute to this reduced prognosis (Valmaseda-Castellón et al. 1999).

It was unlikely spontaneous eruption of the UR6 would have occurred. The space for the UR6 was lacking due to mesial and distal tipping of the UR7 and UR5 respectively, hence orthodontic appliances were indicated to achieve the treatment objectives. The risks of orthodontic treatment include an increase in the prevalence of decalcification and orthodontically induced inflammatory root resorption (Brezniak and Wasserstein 2002; Enaia et al. 2011). Uncertainty over the eruptive potential of the UR6 and the presence of a generally well-aligned Class I malocclusion meant the patient may have been subjected to these effects and other risks for an extended period of time with potentially little benefit. Removable appliances primarily produce tipping movements of teeth around their centre of rotation. They may also allow differential eruption via biteplanes or allow the movement of blocks of teeth. However, they are unable to produce the more complex movements that fixed appliances can deliver and rely on patient compliance (Littlewood et al. 2001). Nonetheless they do have a number of advantages; being removable means they are more easily cleaned (Littlewood et al. 2001). The palatal coverage also provides anchorage, whilst they may affect speech initially they can be more discreet than labial fixed appliances. The benefits of removable appliances are highlighted in this case. Efficient space opening was achieved using finger springs placed distally and mesially to upright UR7 and both the UR5, UR4 respectively. Southend and Adam's cribs provided retention and the baseplate

reinforced both vertical and anterior-posterior anchorage. An anterior biteplane allowed separation of the occlusion hence facilitating efficient tooth movements.

Further alignment of the UR6 was achieved using a sectional fixed appliance. These appliances provide three-dimensional control of teeth when limited treatment goals are planned. For example, the 2x4 sectional fixed appliance has been used in the correction of anterior crossbites (McKeown and Sandler 2001). These advantages were extended to the alignment of UR6 obviating the need for full arch labial appliances and avoiding disruption of a well-interdigitated Class I occlusion. Although occlusal contact with the opposing dentition was established, a slightly infra-occluded position of the UR6 was accepted. This may be a consequence of initial reduced inter-occlusal space due to over-eruption of the opposing LR6 which could have been exacerbated potentially by the anterior bite plane mechanics and the fact that treatment was limited to the upper arch only.

Conclusion

Despite an initial presentation characteristic of mechanical failure of eruption, the unerupted upper right first permanent molar erupted following orthodontic space creation and alignment. The orbital floor was used as a stable reference to assess vertical development. A period of observation may aid in correct diagnosis before invasive procedures are undertaken. This will reduce the risk of unnecessary or inappropriate treatment, financial burden, iatrogenic damage and an inferior result. Treatment options that limit or reduce risks to the adjacent teeth should be employed when the diagnosis is unclear.

Figure legends

Fig.1

Right buccal view (A). Left buccal view (B). Upper occlusal view (C). Pre-treatment orthopantomogram confirming the presence of the unerupted UR6 and mesial and distal tipping of the UR7 and UR5 respectively (D).

Fig. 2

Pre-treatment orthopantomogram (A). Orthopantomogram taken at 12-month review (B). Superimposition of the two radiographs using the orbital floor as a reference point indicates continued vertical development of the UR6 (C) (Red outline).

Fig. 3

An upper removable appliance used to recreate space for UR6 in-situ (A). Orthopantomogram taken at 6 month following commencement of treatment shows space opening for the UR6 and uprighting of the UR7 and UR5 (B).

Fig. 4

Sectional fixed appliance used to open further space for the UR6 (A). Eyelet bonded to UR6 and “piggy-back” mechanics used to erupt the tooth. Lower incisor bracket bonded to UR6 and “piggy-back” mechanics (NiTi archwire beneath bracket) to facilitate extrusion mechanics (C). Progressive further eruption of the UR6 (D).

Fig.5

Right buccal view (A). Upper occlusal view (B). Both images confirm the slightly infra-occluded final position of the UR6.

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